

telephony

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Japan's telecom industry rushes into the information age

Thanks to careful planning and inter-company cooperation, Japanese telecom companies are expected to prosper in international and domestic markets

GENE GREGORY

IF TECHNOLOGY is the main engine of industrial and social change, the mounting wave of telecommunications innovations being introduced in Japan is destined to radically transform structures of economic activity and society as a whole during the remainder of the 20th Century.

The long awaited "information society" finally is emerging from the misty realm of dreams to tangible reality. The imminent privatization of Nippon Telegraph & Telephone Public Corp. (NTT), the launching of Japan's first operational communications satellite and the meteoric take-off of optical fiber production are signals which suggest the shape of things to come.

Changes now underway will have effects on human institutions and behavior as profound as the inventions of printing, the telegraph and the telephone. Office, factory and home already are being transformed.

The effects of new communications already are apparent in the restructuring of old industries and the calling forth of new ones. Japanese copper refiners, which depend on telecommunications for at least 12% of their total turnover, are confronted with declining orders as traditional wire cable is replaced by optical fibers in a widening range of applica-

tions. Cable manufacturers, of necessity, are diversifying from copper wire into glass fiber production, and a new sector of optical fiber component manufacturers is emerging. As communications equipment shifts from the analog to digital mode and as software is increasingly built into systems' firmware, large integrated electronics companies are gaining increasing shares of the market.

A new division of labor is developing among the major communications equipment manufacturers and smaller manufacturers gravitating into their orbits. At the same time, a new breed of software entrepreneurs whose services are required for advanced communications network design is shaking up established patterns of industrial organization, much as Sony, Casio and Pioneer did by spurring the earlier rise of the consumer electronics industry.

Societal commitment

Japanese communications and information industry policymakers have been specifically and wholly committed to the development of information technologies and their societal underpinnings for well over a decade. As a result, microelectronic, computer and consumer electronics firms, along with their labor unions and bankers, are prepared for the incipient communications revolution. Leadership in very large scale integration (VLSI) technology, fifth gen-

eration computer development and optical fiber technology—with special emphasis on mass production and application—place the combined Japanese electronics industry in an appropriate posture to take full advantage of the successive waves of opportunity in the new telecommunications age.

The nucleus of this national information industry complex is the so-called "Denden Family" of approximately 30 major telecommunications equipment suppliers subjected to NTT's rigorous performance specifications and quality standards. Of course, these same firms also have been the most direct beneficiaries of selective technological advances emanating from NTT's original three research laboratories, and by its newest research laboratory.

No less important, these designated suppliers have a substantial, ready market for the products developed jointly within the Denden Family. Although NTT accounts for a steadily declining share of the market for telecommunications equipment—approximately 33% in 1982—its Yen 2.5 trillion annual procurement provides suppliers with substantial relief from the risks inherent in technological change and assures them of important scale and experience economies that serve them well in other markets. In private and export markets, the high performance specifica-

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Gene Gregory is Professor of International Business, Dept. of Comparative Culture, Sophia University, Tokyo.

tions imposed by NTT also become important elements of competitive power.

Despite political pressures from the United States and the projected privatization of NTT, there are likely to be few major changes in these arrangements. The Denden Family derives its strength and reason for being from the inherent nature of telecommunications systems and technology. Their development requires close cooperation at all stages.

Uniformity and systems compatibility are imperative prerequisites of all technologies and equipment. Continuing communications made possible through a finely-tuned cooperative relationship cannot be replaced by arms length, *ad hoc* supply contracts.

There is nothing which requires that all members of the family be Japanese companies, of course, but in the past Japanese companies have been the equipment manufacturers—the logical partners in assuring operation of telecommunications systems.

The mutual obligations of family membership are likely to be even more important in the developing fifth communications age than in previous eras. Based largely on these arrangements, NTT has developed plans for the total overhaul of the telecommunications system during the 20 years from 1981 to 2000. This massive effort to develop a nationwide integrated information network system (INS) entails replacement of all existing cables with fiber optics, digitalization of networks, expansion of data and facsimile services, introduction of new video services, replacement of all existing telephones and other terminals, and the addition of a variety of new terminals for home, office and factory.

The INS will unify all networks through fully digitalized systems, replacing separate systems for different modes of communications: telephone, telegraph, telex, facsimile, data. At the same time, the new integrated system will be equipped with enhanced capabilities to assure projected changes in services:

- From mainly voice to video-intensive transmission.
- From principally man-to-man to more machine-to-machine communications in which computers and automatic remote control systems are active participants.
- To high speed and broadband transmission to accommodate increasing amounts of information.
- To add communications process-

ing functions such as temporary storage, media or size conversion, translation and retrieval of messages as well as computations.

Total cost of this system's revision, in terms of direct capital outlays for equipment, is estimated at Yen 20 to Yen 30 trillion, plus Yen 1.3 trillion annual depreciation, over the 20-year plan period. In addition to these outlays by NTT, which surpass its outlays since it was founded in 1952, derived demand generated by this system—for local networks, exchanges and terminals—is estimated by Nomura Securities to be as high as Yen 60 to Yen 70 trillion.

Given the rapid pace of technological change in the telecommunications industry, however, these estimates could well prove to be conservative. One need only to think back to 1978 to understand the difficulties inherent in such forecasts.

Rand Corp. telecommunications experts in 1978 predicted that 64K microprocessors would be perfected in the early 1980s and reach integration densities in excess of 100K by the latter part of the decade. And they were right, in part. But the timing was off by several years, and by the end of the decade devices will be available with many times the capacity of those forecast. This more rapid pace in large scale integration (LSI) and VLSI technology, in turn, speeds the process of change in telecommunications technologies.

Optical fiber usage has been especially sensitive to the availability of more advanced LSI devices. Sales of optical fiber communications systems in Japan are outstripping earlier forecasts and demand continues to exceed supply even at current relatively high prices. From total sales valued at Yen 70 billion in fiscal year 1981, Daiwa Securities estimates that they will rise to Yen 700 billion in 1985, reaching at least Yen 7 trillion in 1990. Although Yamaichi Research Institute projects a slower growth in the 1980s than the forecast by Daiwa Securities, even this more conservative view of the future foresees optical fiber communications-related sales of Yen 12 trillion by the year 2000.

By the end of next year, NTT will have completed installation of the first trunk line using the large-scale optical fiber communications system that has been undergoing commercial tests since 1982. By 1990, according to plan, the entire nationwide grid, including individual subscriber lines, will be converted to optical fiber cable

and the transpacific optical communications system will be operating between Japan and Hawaii.

Other interests

Telecommunications carriers are by no means the only market for optical fiber manufacturers, of course. Major Japanese electrical power companies have been perfecting their own optical communications systems for monitoring and controlling power grids. Since optical fiber is unaffected by the magnetic field of high-tension cables, Tokyo Electric Power Co. began research on optical communications in 1974 and perfected cable featuring tensile strength 25 times greater than its conventional nylon-coated counterpart, improved heat resistivity and other properties making it possible to combine optical fiber with suspension wire in a unified construction. This fiber-reinforced plastic (FRP) cable was developed with Sumitomo Electric Industries, Furukawa Electric, Fujikura Cable and Hitachi Cable; all four companies currently are producing it for domestic and foreign markets.

Optical fiber communications systems also are being developed for railways, subway systems and expressways. The most elaborate of these new transportation control installations is the integrated digital communications system adopted by the Tozai Line of the Sapporo Municipal Bureau of Transportation. Combining facilities for telephone and announcement services, operation control, power control and sales data processing, this integrated system is expected to serve as a model for other transport systems throughout the country. Major segments of the system have been developed by cooperation between leading firms in the field: Nippon Electric Co. (NEC) and Sumitomo Electric Industries have perfected data transmission systems; Matsushita Communications and Fujikura Cable, image transmission systems; and Fujitsu and Furukawa Electric, power control networks. Private and municipal railways have begun introducing surveillance and control systems employing various combinations of the new optical fiber technologies.

Similarly, optical fiber communications have been adopted by the Hanshin Expressway Public Corp., for monitoring traffic flow and highway communications facilities.

In broadcasting, Nippon Hoso Kyokai (NHK) and private operators

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are using optical fibers for their community antenna television (CATV) networks. NHK also is continuing research with Hitachi Cable to develop a multi-channel optical fiber system for very high frequency (VHF) telecasting. Videotex systems undergoing tests since 1979 have been based upon integrated optical fiber communications.

Other expanding uses of optical fibers include local area networks being established in commercial buildings, companies, universities and research institutes to meet the demand for multi-modal transmission, to link computers to peripherals and satellite earth stations to computer nodes. Manufacturers now are using optical fiber multiplex communications systems in cars, ships and elevators to control electrical equipment, engines and automatic systems.

To meet increasing demand, cable manufacturers have been doubling production annually, with the lead taken by the three firms—Sumitomo Electric Industries, Furukawa Electric and Fujikura Cable Works—which joined NTT in the cooperative research on the vapor phase axial disposition (VAD) method of optical fiber manufacturing. Because market demand has been running ahead of supply, NTT recently has decided to make its patents in this field available to three other large cable manufacturers—Hitachi Cable, Dainichi-Nippon Cables and Showa Electric Wire & Cable—as well.

Although Hitachi Cable, Dainichi-Nippon Cables and Showa Electric Wire & Cable had developed their own optical fiber technology independently, the VAD method has proven to be most advantageous. Larger diameter cables and greater length are obtained in 10% of the production time needed for the most widely-used process, the modified chemical vapor disposition (MCVD) method developed by AT&T Bell Laboratories and Corning Glass in the United States. Hence, in the interest of uniformity and economics of production, NTT has licensed all major Japanese cable manufacturers with its technology.

As a result, at the outset of fiscal year 1983, optical fiber capacity rating of the big six cable manufacturers totaled 32,500 km monthly (see Table 1).

Both Nippon Sheet Glass and Mitsubishi, with their own production methods, also are producing smaller quantities of optical fibers.

Table 1

Manufacturer	Kilometers per /month
Sumitomo Electric Industries	10,000
Furukawa Electric	8,000
Fujikura Cable Works	8,000
Hitachi Cable	3,000
Dainichi-Nippon Cables	2,000
Showa Electric Wire & Cable	1,500
Total	32,500

Three distinguishing features mark the booming Japanese optical fiber industry. First, compared with other national optical fiber industries, the Japanese industry is much less concentrated. In fact, there are as many major optical fiber manufacturers in Japan as in the United States and Europe combined.

Second, each of the Japanese optical cable manufacturers have joined with communications and optical equipment manufacturers of their respective *keiretsu* (industrial or banking groups) in the development of optical fiber production, applications and marketing:

- Sumitomo Electric Industries is linked with NEC and Nippon Sheet Glass, all key Sumitomo Group companies.
- Furukawa Electric has close ties with Fujitsu, since both are members of the Furukawa and Dai-Ichi Kangyo Group.
- Fujikura Cable Works with Toshiba Corp. and Showa Electric Wire & Cable. Toshiba and Fujikura both have Mitsui Group connections.
- Hitachi Cable is a subsidiary of Hitachi, Ltd., and both have common links to the Sanwa Group.
- Dainichi-Nippon Cables, with strong Mitsubishi Group ties, works with Mitsubishi Electric.

These linkages not only assure the necessary financial resources for rapid development of optical fiber production, but also serve to speed the process of optical fiber technology diffusion throughout group companies which embrace many of the main fields of application.

Third, the technological commitment and strength of this basic industry of the information age is formidable. The top three optical fiber manufacturers have acquired MCVD licenses from Corning Glass and pioneered the development, along with NTT, of the VAD method. The other five producers all de-

veloped their own technology, and three of these have also been licensed to use the NTT's VAD process.

In fact, Hitachi Cable has developed two optical fiber production methods of its own. One of them, the soot deposition method, is similar to the VAD process and has almost all of the latter's advantages over the MCVD method. In addition, however, Hitachi Cable has jointly developed a single polarization monomode (SPM) fiber with Hitachi, Ltd., which permits light to travel straight down the axis of the fiber, reaching its destination before light which bounces down the cable, which is the usual method.

While tests on its wider application still are being conducted, this new fiber has found many non-communications applications in high precision optical fiber gyroscopes, blood flow meters, interferometers, magnetic or electric field measurement as well as connections between circuits. SPM-type communications using very high quality optical fiber measuring 10 microns or less in diameter are envisaged by NTT in a new public telephone service to be inaugurated in 1987 or 1988.

By then the impact of optical fiber communications already will be far reaching. Per channel costs of glass fiber transmission will be only a fraction of existing tariffs. Since higher information carrying capabilities make make possible transmission of all communications modes on the same circuit, costs will be further reduced through their integration.

Other developments

Lower service costs, broader transmission capabilities and the speed of communications also will be enhanced by improvements in microwave communications, satellite services and digital switching systems. Japan's first commercial communications satellite, Sakura 2, which went

into service last June with 4000 telephone circuits, will be joined by a second satellite in 1987 carrying 6000 circuits and more advanced craft in the 1990s with as many as 200,000 circuits. Although limited to back-up emergency services at the outset, satellite transmission will be used as relay transmission lines working in conjunction with optical fiber cable systems on the ground to form a highly reliable dual network.

In addition to these communications carrier satellites, broadcasting satellites will provide improved services for existing public and private networks, as well as new cable television systems. A group of three companies—Marubeni Corp., the Chunichi Shimbun and Uny Co., (respectively, a trading company, a leading newspaper and a major super-market chain)—are preparing to launch a combined pay and free cable television service for the Nagoya region using a communications satellite in 1985. By 1988, the third Japanese broadcasting satellite, the BS3, will be launched, joining the BS2.

More diversified communications services at lower costs are being matched by similar developments in terminals made possible through application of successive generations of LSI circuits and more advanced VLSI circuits. The result is a boom in telecommunications terminals for offices and homes which will gain momentum after 1985 when the INS becomes operational. New high definition television receivers with flat screens and multiple functions which will be fully digitalized, will replace existing models.

Data communications services will give added impetus to personal computer usage, speeding the convergence of television with computer terminals. All existing telephones and switchboards will be converted to digital models. Developments in mobile communications are opening new markets for automobile radio telephones, cordless telephones and, ultimately, fully portable telephones. That powerful sleeping giant, facsimile communications, finally is awakening to an era of general office and home usage.

Although the take-off of new television services and digital receivers is still a few years off, car telephone services, begun in 1979, had been extended to approximately 200 cities with more than 20,000 subscribers by mid-1983. More economical base station equipment and a compact, low cost mobile radio put into commer-

cial use in 1982-83 are expected to give a new boost to domestic demand. Meanwhile, leading Japanese firms, especially NEC and Matsushita Communications Industrial, are preparing for the huge United States market, where 1 million to 1.5 million mobile units are expected to be installed in automobiles during the next 10 years. The Middle East and Western Europe also are focal points of Japanese export interest. Matsushita Communications already has established its position in the car telephone market of the United Arab Emirates and Kuwait, and Mitsubishi Electric has begun exports to Western Europe, with initial exports going to the promising Swedish market.

Portable radio promises to be an even brighter star in tomorrow's communications firmament. As many as 20 Japanese manufacturers are already in the market, which industry analysts estimate will be worth Yen 2.2 trillion annually by the end of the decade. A rush for portable, high performance radio sets was triggered by the Ministry of Posts and Telecommunications' action in 1983 to rewrite the national Telecommunications Law, giving increased access to radio waves by private citizens.

This growth in mobile communications has been overshadowed by burgeoning facsimile equipment sales. While new models were improved in both efficiency and quality, prices dropped precipitously during 1982 as a result of increasing miniaturization and the introduction of advanced microelectronic devices. The response was electrifying. Unit sales rose 77% in 1982, producing a 30% increase in sales revenues.

Output of facsimile equipment in fiscal year 1983 was expected to reach 350,000 sets, which would mean a total turnover for the industry of approximately Yen 180 billion. But estimates of future growth vary widely. The conservative forecasts of the Communications Industry Assn. of Japan (CIAJ), predicting output of Yen 257 billion in 1985, have been scrapped. A more sanguine view, held by EDP Japan Report, estimates 1985 output at Yen 300 billion, rising to Yen 350 billion in 1986.

Evidence supporting the more optimistic outlook is convincing. The current boom in NTT mini-fax rentals, which has gained momentum steadily since introduction of the service in September 1981, will be further fueled in 1984 when Denden launches the new economical and compact

Mini-fax 2 capable of transmitting an A4 copy within 3 minutes. By 1986, all major cities in Japan will be included in the public facsimile network, which then will be integrated with other communications networks in a single digitalized optical fiber system scheduled to be fully operational by 1990.

More than 25 companies are racing to develop new, high speed units, dual purpose fax-copying machines and combinations of fax with word processors, microfilm and optical character reading equipment, which are all calculated to increase the attractiveness of facsimile services to users.

With these and other improvements in the offing, the number of facsimile installations is expected to increase from 300,000 at the end of 1982 to 10 million in 1990. Since this estimate is based on an 80% saturation of the office equipment market and only a modest 10% penetration of the home market, the wide scope for further growth in the 1990s is expected to sustain the sizeable number of producers in the industry.

Exports will spur the internationalization of major facsimile equipment producers. Although overseas shipments rose only 7.6% in the first 7 months of 1983, total 1982 exports shot up 83% to approximately Yen 40 billion, representing a 68% increase in volume to 63,300 units. The higher increase in the value of exports, exceeding the increase in export volume, reflects the greater advantages of Japanese higher-speed terminals.

Significantly, the relatively high rate of exports, which amounted to almost 27% of total sales in 1982, has been sustained less by direct marketing abroad by Japanese firms than by United States and European OEM (original equipment manufacturer) purchases in Japan. These supply arrangements, as of 1982, are illustrated in Table 2.

By comparison, leading Japanese manufacturers are estimated to have shipped only 15,000 units to the United States and 5000 to 6000 units to Europe under their brand names.

Indications are that this pattern of supply will continue for the foreseeable future. With rapid improvements in production efficiency through the application of more automated mass production methods Japanese manufacturers have reduced unit prices by more than 26% since 1980. Technological innovations, especially in LSI design and applications, have not

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Table 2

U.S.	Units	Europe	Units
Fujitsu to Burroughs	5000	Fujitsu to ITT Europe	3000
Murata to Burroughs	3000	Mitsubishi Electric	
Oki Electric to		to Siemens	2000
Pitney-Bowes	7000	Ricoh to Kalle Infotec	2000
Toshiba to Pitney-Bowes	8000	Oki Electric to DeTeWe	2000
Hitachi to Southern		Oki Electric to	
Pacific Communications	2000	Muirhead Corporation	2000
Hitachi to Telautograph	2000		

only brought miniaturization and higher quality, but also have lowered the costs of parts and components. Moreover, Japanese facsimile units now are equipped with levels of functionality unmatched by those produced in the United States and Europe.

As a result, in 1982 the British Post Office and the Swedish Telecommunications Agency (STA), for example, concluded contracts directly with Matsushita Graphic Communications for supply of mini-fax machines. Since the STA reportedly is planning to use Japanese mini-fax equipment in its nationwide communications network redevelopment program, Japanese facsimile exports to Sweden alone could amount ultimately to hundreds of thousands of units.

Spurred by this rise in exports of facsimile sets, overseas shipments of telecommunications equipment rose a spectacular 57.1% in 1981 and continued upward at a 21.7% rate in the first 7 months of 1983. Prospects are that, just as exports have led the growth of other electronic industry sectors in the past, the growth in the Japanese communications industry during the 1980s will be spurred by overseas sales. By 1986, exports are expected to account for approximately 30% of total telecommunications equipment shipments.

Market targets

At the same time, Japanese equipment manufacturers will move toward increasing manufacture of major products in key foreign markets. NEC, Fujitsu and Oki have begun to manufacture PABXs (private automatic branch exchanges) in the United States, and Fujitsu has plans for United States production of optical fiber communications-related equipment, the fiber excepted, in conjunction with an order from MCI Communications for installation of a

long distance optical fiber communications system between Washington and New York.

Parallel to the rise in exports, private demand for communications equipment in Japan will continue to grow faster than purchases of NTT, Kokusai Denshin Denwa Co. Ltd. (KDD) and other public sector users. In 1986, equipment sales to the private sector are expected to exceed Yen 697 billion, estimated at 35.5% of total production, or about the same as the 35.6% taken by sales to public communications systems operators.

Further liberalization of the market for telephones and interconnect regulations for value-added networks will have a significant impact on the market for new generations of terminal equipment. Not only will an increasing share of home telecommunications equipment be sold by the manufacturer to the consumer through a variety of retail outlets, but customer-premises sales of digital exchanges, key telephone systems and local area networks will grow rapidly.

Radical changes in technology, combined with changing patterns of demand are transforming the structure of the telecommunications equipment industry. With the development of optical fiber communications, cooperation between cable manufacturers and equipment manufacturers is becoming even closer than it was in the age of copper wire. Satellite communications, a macro-technology susceptible to management only by large-scale enterprises, will increase the share of major equipment manufacturers in transmission equipment markets. Similarly, digital exchanges, like mainframe computers, have high levels of minimum efficient scale of production and, therefore, are likely to add to the power of major manufacturers in the marketplace.

Small and medium-sized telecom-

munications equipment manufacturers will lose market share for cable, transmission equipment and exchanges to the larger diversified communications companies, on the one hand; on the other hand, they will be faced by rising competition for terminal markets from consumer electronics and office equipment manufacturers.

Virtually all major appliance manufacturers and office equipment manufacturers have diversified into telecommunications terminal production in recent years and are likely to be leading suppliers of personal computer—or data communications—terminals and facsimile equipment, as well as television and other video equipment connected to the communications network.

Indeed, the advantage of appliance manufacturers is so strong that major communications equipment firms, such as NEC, are investing heavily in consumer electronics production to acquire the mass production capabilities that will be required to compete effectively in the terminal markets of tomorrow.

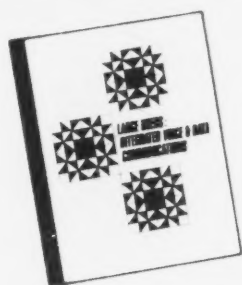
Trepidation

Quite understandably, foreign communications equipment suppliers view this trend with mixed feelings. While some specialized communications equipment manufacturers are confident they will be able to compete more effectively in the Japanese market after privatization of NTT and with the growing importance of the private sector, others are less optimistic.

Just as improved technology, higher domestic performance specifications and quality standards, and superior mass production capabilities are serving to make Japanese communications equipment increasingly attractive abroad, foreign suppliers will have to compete with this combination of advantages in the Japanese domestic market. Private buyers tend to be just as concerned with performance and quality as the public services, and they are even more impervious to international political pressures.

But that is not all. "There is the classic problem of interface between foreign manufacturers and the Japanese market that must be solved," a Tokyo representative of one leading international equipment manufacturer confessed. "The home office blames the Japanese and the branch office for failure to penetrate the mar-

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The results of the 1984 survey of large users shows better than 70% of corporate users will have integrated voice-data communications departments by 1986. Accompanying that integration is the authority to integrate voice and data facilities, with markedly increased plans for digital termination (bypass) facilities and purchases of voice-data PBXs.

Over 30 key system and PBX manufacturers and over 50 modem, multiplexer and data switch manufacturers were named by the telecom professionals as coming to mind when considering purchases. But, manufacturers need to be cautious, since sector usage levels and demands vary.

The large user is making distribution channels as important as the equipment manufacturer. The integration of voice and data communications also is increasing the degree of centralized buying. The surveyed corporations' HQ telecom staff control 31% to 83% of voice and data communications acquisitions in locations ranging from 1-9 employees on up to over 1000 employees, underscoring emphasis on network compatibility, and backup service, which past surveys have shown as the most important factor in purchase decisions.

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ket, but is not prepared to do the homework or modify the equipment to meet NTT standards. "We have to face the facts," he continued. "NTT standards are tighter, and in other ways special, but they are not going to relax them simply to please or accommodate foreign suppliers."

The plain truth of the matter is that, for many of these firms, meeting Japanese (not only NTT) specifications at competitive prices and normal business risks is not feasible. The volume of sales, under the best of all possible conditions, often does not warrant the investment.

But there are signs that the market is changing for some foreign suppliers. NTT has established technological ties with both International Business Machines Corp. (IBM) and American Telephone & Telegraph Co. (AT&T) which should facilitate the development of compatible systems and equipment, thus enabling these top American companies eventually to share in the Japanese market for the big ticket items which are their strengths. Motorola has been selected as a designated supplier, not only for pocket paging systems, but also for cellular telephones. Rolm has received NTT approval of its digital PABXs and private firms have been buying Rolm computerized branch exchanges (CBXs), which first appeared on the Japanese market as recently as April 1982. Fortified with this success, the company is resolved to capture 3% to 4% of the market for this type of equipment.

As a harbinger of things to come, last October Ichio Kato, NTT's director of international procurement, announced in Washington the placement of orders for an advanced traffic observation and management information collecting system from AT&T International, a \$21 million supercomputer system from Cray Research, and a \$4.3 million transportable digital switching system from Northern Telecom. Although sales of American firms to NTT have been doubling every year since 1981, when the agreement between the United States and Japan was signed giving American firms the right to compete on equal terms for NTT procurements, this was the largest set of U.S. equipment purchases to date.

By current industrial standards, the pace of NTT's liberalization signals a major change in policy, a change which is further reflected in the new open tender system of procurement. To expect radical changes in patterns of supply, even if the quality and

prices of products are competitive with those being used, flies in the face of the reality of telecommunications systems' imperatives.

All products must be compatible with the total system and with its various components, which usually means that individual products must be designed for the needs of the system if optimal results are to be obtained. This limits the number of equipment items that can be bought off the shelf and requires rather lengthy lead time between the design stage, the placement of orders and final delivery.

The question suppliers are asking now is: Will NTT continue on its present course of liberalization after it becomes a private corporation?

Although NTT will not be legally bound to comply with the procurement agreement once its status as a public corporation is withdrawn, there are good reasons to expect that purchases abroad will continue to increase. As an executive of one American equipment supplier put it: "The important thing is that recent changes in the climate induce foreign firms to try harder."

But, equally important, NTT will no doubt remain committed to the path of cooperation it has taken with its recent technical relationships abroad.

There are also some sound technical and economic reasons for an increasing specialization and international division of labor as telecommunications technologies and products proliferate. As uniformity in global communications systems becomes increasingly important, there is likely to be a growing trend towards standardization and compatibility of systems and equipment. Closer cooperation between communications utilities and suppliers throughout the world, therefore, becomes one of the positive features of the fifth communications age.

Liberalization of communications systems the world over also will enhance the importance of private sector markets and increase world trade in communications equipment. Although Japanese telecommunications equipment manufacturers will be major competitors in this new global environment, effective competition in this field often requires international cooperation.

Increased international competition and cooperation thus become the logical pattern for members of the communications industry in the information age. □